

by olfactometry were scanned in a Magna 760 FTIR spectrometer (Nicolet, Madison, WI) using an 84-meter path length gas cell. Scans were obtained over a period of about one minute and from 4000 to 740 cm^{-1} with a resolution of 0.5 cm^{-1} . Spectral data were correlated with olfactory data using partial least squares regression with full cross-validation (using The Unscrambler, Camo, Trondheim, No). Air samples were obtained from experiments with pigs fed diets formulated to alter odor emission. Due to low ventilation rates (15 $\text{m}^3/(\text{pigplacehour})$), high odor intensities were obtained, averaging 997 ± 585 , with a range from 248 to 2161. Using these samples, a prediction error for odor sensation of 461 odor units ($r^2=0.36$) was obtained. It is estimated that the measurement error of olfactometry is 300 units which limits the r^2 of any method to approximately 0.75. Thus, this calibration, even though it is based on a small number of samples, is encouraging. By adding 23 samples collected under production conditions the prediction error could be further improved to 373 ($r^2=0.51$) but the use of two sources of samples may affect the validity of this calibration. In conclusion, FTIR shows promise as an optical nose, but its true potential needs to be tested with a large number of field samples.

Key Words: Infrared, Odor, Swine

204 Odor solutions initiative manure pit additive testing results. C. L. Tengman^{*1}, R. N. Goodwin¹, A. K. Gralapp-Gonzalez¹, A. J. Heber², J. Q. Ni², K. J. Fakhoury², and A. L. Sutton², ¹National Pork Board, Des Moines, IA, ²Purdue University, West Lafayette, IN.

Thirty-five manure storage pit additive odor control products were evaluated in triplicate. Each product was tested in an enclosed 15-inch

205 Effects of estradiol (E) and pregnant mare serum gonadotropin (PMSG) on follicular growth in neonatal pigs. P. E. Davis^{*} and M. C. Lucy, University of Missouri-Columbia.

Previously we found that pigs treated with E had fewer primordial follicles but equivalent numbers of growing follicles compared to control. We hypothesized that follicles initiated growth in response to E but failed to continue growth because of E-induced reduction of FSH. To test our hypothesis five-day-old piglets ($n=31$) were treated in a two by two factorial design: T1, E (two-24 mg E implants) and PMSG (10 iu/kg injected twice weekly); T2, sham implanted and PMSG; T3, E implants and saline injection; and T4 (control) sham implanted and saline injection. Blood was sampled weekly and ovaries were collected on d 45 of treatment. Pigs treated with E had greater serum E than control (213 vs. 6 pg/ml; SEM=22; $P<.001$). There was a main effect of E ($P<.001$) and a tendency for an effect of PMSG ($P<.10$) for combined ovarian weight (0.24 .01, 0.18 .01, 0.23 .01, and 0.15 .01 g for T1 to T4). Histological follicle classifications were: primordial [oocyte with no cuboidal granulosa cells (CGC)]; F0-1 (oocyte with CGC and flattened granulosa cells); F1 (oocyte with one complete layer of CGC); F1-2 (oocyte with more than one layer of CGC, but not two); and F>2 (oocyte with more than two layers of CGC). There was a main effect of E ($P<.001$) and PMSG ($P<.005$) for primordial follicles because E decreased the number of primordial follicles whereas PMSG increased the number of primordial follicles per field (38.2 8.0, 95.6 7.4, 29.1 8.0, and 53.4 8.0 for T1 to T4). There was also a main effect of E on growing follicles (F0-1, F1-2, and F>2) because E decreased the number of F0-1 (52 vs. 82; SEM=6; $P<.001$), F1-2 (15 vs. 34; SEM=4; $P<.001$), and F>2 (.2 vs. 3.7; SEM=.8; $P<.01$) follicles per section. E did not affect the number of F1 follicles. PMSG did not affect the number of growing follicles (F0-1, F1, F1-2, and F>2). In summary, E increased ovarian weight while reducing the number of primordial and growing follicles. PMSG increased the number of primordial follicles and had no effect on growing follicles in either T1 or T2 pigs.

Key Words: Pig, Follicle, Estradiol

diameter by 48-inch tall cylinder. The test cylinders were located in an environmentally controlled room where the temperature was held at 20°C. Each cylinder was continuously ventilated with 7 Lpm of odor-free air. Periodic manure and product additions were made throughout the 42-day trials. Manure added to the cylinders was collected from a commercial swine grow-finish farm with a shallow pit manure system. All products were tested as prescribed by the vendors. Ammonia and hydrogen sulfide emissions from each cylinder were measured automatically several times a day. Air samples were collected four times during each trial and evaluated for odor concentration using olfactometry. Initial and final manure characteristics were also analyzed. Product effectiveness was determined by comparing odor, hydrogen sulfide, and ammonia measurements in treated cylinders against measurements in untreated cylinders. Statistical analysis provides measures of probability of differences in product activity. Results are reported at 75% and 95% levels of certainty. At 95% certainty, 0 products were found to reduce odor, 7 reduced hydrogen sulfide up to 47%, and 8 reduced ammonia up to 15%. At 75% certainty, 4 products reduced odor up to 32%, 3 reduced hydrogen sulfide up to 19%, and 4 reduced ammonia up to 3%. Overall, 20 products had a positive affect on reducing one of the three air emissions measurements.

Key Words: Odor Control, Pit Additives, Manure Additives

206 Effect of PG600 given at d 7 post-weaning on follicular development, estrus, and ovulation in sows classified as anestrus in a commercial swine herd. C.J. Bracken^{*}, J.S. Seaman, T.J. Safranski, and M.C. Lucy, University of Missouri.

PG600 (400 units PMSG and 200 units hCG, Intervet, Millsboro, DE) is given to induce estrus and ovulation during the period of seasonal anestrus. The objective of this study was to examine follicular dynamics and the relationship between estrus and ovulation in sows not observed in estrus by d 7 post-weaning and treated with either PG600 or saline (control). The study was conducted at a commercial swine farm in Marshall, MO during August 2001. Sows ($n=57$) were weaned in three groups at 15.2 0.3 d after farrowing. Sows that did not exhibit estrus by d 7 post-weaning were randomly assigned to receive a 5 mL IM injection of either PG600 ($n=28$) or saline ($n=29$). Transrectal ultrasonography was performed once daily beginning on the day of treatment (d 0) and continued for 6 d. Follicular diameter was measured and time of ovulation was recorded. Estrus detection was performed once daily using fenceline boar contact. There was an effect of group on follicular diameter ($P<0.01$) because follicles were smaller for group 1 (4.2 0.2 mm) compared to groups 2 (4.8 0.1 mm) and 3 (4.7 0.2 mm). Follicles in PG600 and saline treated sows had similar diameter on d 0 (4.0 0.1 mm vs. 4.2 0.1 mm). By d 6, follicular diameter had increased for PG600 sows but not saline sows (6.0 0.2 mm vs. 4.1 0.1 mm; $P<0.001$). Greater follicular development in PG600 sows was associated with an increase in percentage of sows in estrus ($P<0.001$) and percentage of sows ovulating within 6 d ($P<0.001$) for PG600 (93.1 and 72.4%) compared to saline (32.1 and 10.7%). The treatment by group interaction was not significant for percentage of sows in estrus or ovulating. Treatment to estrus interval (3.7 0.3 d) and estrus to ovulation interval (2.0 0.1 d) were similar for PG600 and saline sows. We conclude that summertime PG600 treatment of anestrus sows at d 7 post-weaning increases follicular development and the number of sows expressing estrus and ovulating within 6 d of treatment.

Key Words: PG600, Sow, Anestrus

207 Failure of endogenous follicle-stimulating hormone (FSH) to stimulate early ovarian growth in prepubertal gilts. J. J. Ford*, T. H. Wise, and R. K. Christenson, *USDA, ARS, RLH US Meat Animal Research Center.*

Prepubertal gilts of three genetic lines selected for increased ovulation rate have greater plasma FSH concentrations (10 - 25%) than observed in gilts of respective control lines (Cassady et al., 2000; Ford et al., 2001). The objective of the current study was to determine if ovarian weights at 85 d of age were influenced by endogenous FSH. Gilts from a line selected for greater number of corpora lutea (OR, n = 137) and from the control line (CO, n = 138) were bled at 65 and 75 d of age. At 85 d of age, gilts were moved to preoperative pens in a surgery facility. Blood samples were collected followed by high lumbar laparotomy and removal of one ovary. Side of ovariectomy was alternated within littermate gilts. The study was conducted in spring and fall seasons. Body weight was greater ($P < 0.05$) in CO than in OR gilts at 56 and 154 d of age. Plasma FSH concentrations, determined by radioimmunoassay, were 19% greater ($P < 0.001$) at 65 d of age and 13% greater ($P < 0.001$) at 75 d of age in OR than in CO gilts. Ovarian weight (range 0.05 - 2.34 g) was slightly heavier ($P < 0.09$) on the left than on the right side (0.68 vs 0.40 g). Plasma FSH concentrations at 85 d (3.6 vs 3.7 ng/mL) and ovarian weight (0.47 vs 0.46 g) were similar in CO and OR gilts, respectively, but ovarian weight was correlated negatively with plasma FSH concentration ($r = -0.29$, $P < 0.01$). Ovarian and 56-d body weight were not affected ($P > 0.2$) by season. For gilts in the first season, pubertal age was similar ($P > 0.5$; 206 vs 203 d) in the two lines; luteal phase ovarian weight adjusted for number of corpora lutea was heavier ($P < 0.05$) in OR than in CO gilts. Puberty and ovarian weight data are being collected for gilts in the second season. FSH concentration and negative correlation of FSH with ovarian weight indicate that negative feedback control of FSH secretion by the ovaries is operative at 85 d of age in both lines. In addition, ovarian weight prior to 85 d of age is not stimulated by the greater circulating FSH in OR gilts observed on d 65 and 75.

Key Words: Ovulation, FSH, Ovary

208 The effect of progesterone treatment on day 2 and 3 of pregnancy on gestation length, litter size, birth weight, and piglet growth rate in intact white crossbred pigs. J. L. Vallet*, *USDA, ARS, RLH US Meat Animal Research Center.*

Previous results indicated that treatment of unilaterally hysterectomized-ovariectomized white crossbred gilts on d 2 and 3 of pregnancy with exogenous progesterone increased fetal weights at 105 d of gestation and decreased uterine capacity. Because the incidence of stillbirths is associated with underweight piglets, the objective of the current experiment was to determine whether early progesterone treatment could be used to decrease the number of stillborn pigs per litter in intact white crossbred gilts. Gilts were mated at estrus and received either no treatment (n=78) or progesterone injection (200 mg/d, i.m.; n=34) on d 2 and 3 of pregnancy. Gilts were then allowed to farrow and gestation length, number of fully formed piglets, number born alive, and birth weights were recorded. Piglets were weighed again at weaning (approximately 21 d) and at approximately 56 d of age. Progesterone-treated gilts did not differ from control-treated gilts in the number of fully formed piglets (9.44 ± 0.43 and 10.18 ± 0.29 , respectively) and number of piglets born alive (8.76 ± 0.45 and 9.4 ± 0.3 , respectively), resulting in no difference in the number of stillborn piglets per litter (0.68 ± 0.19 and 0.78 ± 0.13 , respectively). Progesterone treatment shortened ($P=0.05$) gestation length (115.47 ± 0.21) compared to control (115.97 ± 0.14). Piglet birth weight for progesterone-treated gilts did not differ from piglet birth weight for control gilts (1.60 ± 0.04 and 1.57 ± 0.03 kg, respectively; analyzed both before and after adjusting for number of fully formed piglets), weaning weight (5.43 ± 0.14 and 5.13 ± 0.09 kg, respectively; analyzed after adjusting for actual day of weaning and number weaned) and weight at 56 d of age (17.07 ± 0.47 and 16.46 ± 0.30 , respectively; analyzed after adjusting for actual day weighed). These results indicate that early progesterone treatment shortens gestation length but has no effect on litter size in intact pigs. Furthermore, progesterone treatment does not affect birth weights of the piglets, the number of stillborn piglets or the subsequent growth rates of piglets born alive.

Key Words: Progesterone, Stillbirth, Fetus

209 Altering sperm membranes to improve cryosurvival. J.K. Graham* and P.H. Purdy, *Colorado State University.*

Damage can occur to sperm at any step during cryopreservation, however, sperm are particularly vulnerable when undergoing freezing itself and when cryoprotectants are removed. Cell damage at these steps may be ameliorated if membrane permeability fluidity were increased. Experiments were conducted to alter sperm membrane composition to improve cell cryosurvival. Cyclodextrins pre-loaded with cholesterol (CLC) were added to bull sperm to increase the cholesterol level in the sperm plasma membrane. Initial experiments optimized this procedure by monitoring sperm motility after cryopreservation. Sperm treated with 0, 0.75, 1.5, 3.0, 4.5, 6.0 or 7.5 mg CLC resulted in 42, 58, 60*, 57, 54, 53 and 48% motile cells, respectively, after thawing (* different from control at $P < 0.05$). When 120 million sperm were treated with 0, 0.75, 1.5, 3.0 and 6.0 mg of cyclodextrin that were pre-loaded with fluorescently labeled cholesterol, 0, 0.0625, 0.0875*, 0.1125* and 0.1475* μM of cholesterol, respectively, were detected in the samples. Additional experiments, utilizing flow cytometry indicated that all sperm within a single treatment contained similar levels of cholesterol. Addition of cholesterol to the sperm altered membrane physiology, by making the plasma membrane more permeable to glycerol. When control and CLC treated sperm were cryopreserved and used to fertilize bovine oocytes, in vitro, similar percentages of oocytes were fertilized 48 and 46%, when equal numbers of live sperm were added. Finally, when 32 heifers/treatment were inseminated with 750,000 total cryopreserved sperm, pregnancy rates were 50 and 59% for control and CLC treated sperm. Increasing the cholesterol content of bull sperm membranes alters sperm membrane physiology permitting greater numbers of cells to survive the cryopreservation process. In addition, CLC treated sperm are capable of fertilizing oocytes in vitro and in vivo. Finally, such treatment may be able to improve the fertilizing potential of frozen semen and/or permit fewer spermatozoa to be used in an insemination dose. Supported by USDA 2000-02410 and NAAB.

Key Words: Cryopreservation, Cholesterol, Spermatozoa

210 Interaction of bovine sperm with oviduct cells modifies intracellular pH regulation of sperm. J.J. Parrish*¹ and C.M.O. Medeiros², ¹*University of Wisconsin-Madison*, ²*Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.*

As sperm move up the female reproductive tract they colonize the first portion of the oviduct isthmus by binding to epithelial cells. One of the important functions of sperm binding in the isthmus is that it prolongs sperm viability. In vitro, the ability of oviduct epithelial cells to prolong sperm viability also requires sperm binding. The mechanisms however by which sperm survival is prolonged have not been identified. We have investigated the effect of bovine sperm binding to bovine oviduct epithelial cells on the regulation of sperm intracellular pH (pH_i). The pH_i of bovine sperm was determined by quantification of BCECF fluorescence in sperm loaded with acetoxymethyl ester of BCECF. Upon binding of sperm to oviduct epithelial cells, sperm pH_i at 0.5 hr was 6.700.02 and increased to only 6.750.01 by 6 hr. In contrast, sperm incubated in medium alone (control) had a pH_i of 6.740.02 at 0.5 hr and increased to 6.890.02 by 6 hr. The binding of sperm to oviduct epithelial cells prevented the increase in pH_i seen in control sperm during incubation ($p < 0.05$). To better understand the regulation of sperm pH_i , the recovery of sperm pH_i after an intracellular alkalization was fit to an exponential decay equation with a single rate constant. While the rate constant was not affected by sperm binding to oviduct cells ($p > 0.05$), the instantaneous velocity of recovery as measured at pH 7.1 was greater for sperm bound to oviduct cells ($p < 0.05$) at both 0.5 hr (294 vs 212 nmol H^+ /min) and 6hr of incubation (202 vs 52 nmol H^+ /min). The intracellular buffering capacity of sperm did not change relative to the control sperm at either 0.5 or 6 hr of incubation ($p > 0.05$). The results support the activation of a sperm acidification mechanism upon binding of bovine sperm to oviduct cells. Bovine sperm pH_i is lower than the medium sperm are bathed in either in vitro or in vivo. Unless an acidification mechanism is activated, the pH_i of sperm will gradually increase upon incubation either in vivo or in vitro. Increases in sperm pH_i are known to be associated with sperm activation, capacitation and their

eventual death. Preventing the inevitable increase in pH_i by activating an acidification mechanism would then prolong the viability of sperm.

Key Words: Bovine Sperm, Female Reproductive Tract, Sperm Physiology

211 Commercial application of mammalian sperm sexing. D.L. Garner* and G.E. Seidel, *Colorado State University*.

The process of sexing mammalian sperm by flow cytometry has been progressively developed over the last 20 years, and now is being commercialized. This sexing process, which is based on DNA content differences between X- and Y-chromosome-bearing sperm, utilizes the DNA-specific bisbenzimidazole dye, Hoechst 33342 to accurately measure the DNA content of stained sperm with a flow cytometer/flow sorter. Stained bovine sperm can be sorted routinely at rates of about 5,000 live sperm of each sex/sec at 90% accuracy. About 80% of those sorted can be recovered for use, resulting in production of around 15 million live sperm of each sex per machine per hour. Sex-sorted bovine sperm usually are packaged in 0.25-ml straws at 1.5 to 3 million sperm/dose and cryopreserved for later use. More than 10,000 heifers have been bred with sex-sorted, cryopreserved bovine sperm, resulting in pregnancy rates of 50% in well-managed herds in which pregnancy rates are about 70% with unsexed control sperm. There is little information available about the use of sexed sperm with high-producing dairy cows. Sexing accuracy is routinely about 90% for the selected sex. The economic issues of commercial application of this technology to cattle and other domesticated species are yet to be determined.

Key Words: Flow Cytometry, Fertility, DNA Content

212 Sexual dimorphism among blastocysts may provide for sex ratio adjustment in the bovine. R. M. Roberts*, K. Kimura, and M. Larson, *University of Missouri-Columbia*.

In species that live in socially structured herds or flocks, females in good body condition or of high social rank produce more male offspring than females. Increased dietary energy appears to be the factor that skews the sex ratio in favor of males. Although the situation is less clear in cattle, the sex ratio of males to females becomes significantly greater than 1:1 where herd nutritional status is high. One means of discriminating between sex of embryos could arise if one sex signaled its presence to the mother more robustly than the other. Alternatively, the environment of the reproductive tract might favor embryos of one sex over the other. Here we discuss two kinds of sexual dimorphism in bovine embryos that might allow cows to adjust the sex ratio of calves borne. The first is in the production of interferon-tau (IFN-tau), a protein secreted by trophectoderm and responsible for preventing the regression of the CL during early pregnancy. We show that expanded female blastocysts produce about twice as much IFN as males. Since male blastocysts release less, rather than more, IFN-tau than females and do not appear to produce it earlier, it is unlikely that the strength of IFN signaling can account for the greater success of male embryos in establishing a pregnancy in cows on a high plane of energy nutrition. A second form of polymorphism is the superior ability of male *in vitro* produced bovine embryos to survive in a glucose-rich medium. Glucose concentrations in the reproductive tract are low following implantation but rise with the onset of the luteal phase. Such a change may be accelerated in well-fed cows, thereby providing male embryos with a survival advantage. We speculate that these differences between the sexes are manifestations of phenomena that occur naturally *in vivo* and could provide plasticity in embryo selection during the establishment of pregnancy. The higher production of IFN-tau by female blastocysts may offset some of the advantages males have to survive a nutrient rich, and potentially hostile uterine environment.

Key Words: Interferon-Tau, Glucose, Pregnancy

213 A review of the estrous cycle in beef cattle: Physiology, endocrinology, and follicular waves. F. N. Kojima*, *University of Missouri, Columbia*.

Estrus synchronization is a valuable tool to enhance reproductive management in beef cattle. Procedures that can: 1) facilitate synchronization of estrus in cycling cattle; and 2) induction of an ovulatory estrus in periparturient heifers and postpartum anestrous cows, will increase reproductive rates and expedite genetic progress through use of artificial

insemination (AI). Managing reproduction in beef cattle requires a thorough understanding of changes in physiology and endocrinology that occur during the estrous cycle and the transition from anestrus to cyclicity. Successful reproductive management requires the successful application of available knowledge to current estrus synchronization protocols. To that end, this review will cover the basic physiology and endocrinology of the estrous cycle, provide an overview of our current understanding of follicular waves, and address considerations related to anestrus. Topics to be covered that will specifically address basic physiology and endocrinology of the estrous cycle include: 1) follicular development; 2) endocrinology associated with follicular development; 3) corpus luteum development and regression; 4) endocrinology associated with corpus luteum function; and 5) a summary of the estrous cycle. Consideration of anestrus will specifically relate to conditions that include: 1) the prepubertal and periparturient period in heifers; and 2) the postpartum period in cows. Various available estrus synchronization protocols utilize several key components, such as prostaglandin $F_{2\alpha}$, GnRH, and progestins. This review will include an overview of these components and their applications. A better understanding of physiology and endocrinology of the estrous cycle will improve reproductive management of beef cattle and facilitate the successful application of estrus synchronization protocols. This, in turn, will increase use of AI and hasten genetic improvement in beef cattle production systems.

Key Words: Estrous Cycle, Beef Cattle, Estrus Synchronization

214 Synchronization of estrus in beef heifers with MGA and PGF. D.J. Kesler*, N.R. Wherley, and D.B. Faulkner, *University of Illinois*.

Considerable research has been done to develop an consistently efficacious procedure to synchronize estrus in beef heifers. The MGA/PGF procedure has emerged as the procedure of choice; however, the original procedure required the detection of estrus for breeding. In a survey of beef producers, we have found that the major reason beef producers do not use synchronize estrus is the lack of time and labor. When given a choice between using a procedure that requires breeding upon estrus detection or at a predetermined time, 85% chose timed AI. The MGA/PGF procedure involves the feeding of 0.5 mg of MGA/heifer/day for 14 consecutive days followed by an injection of PGF 19 days after the last day of MGA feeding. Although an interval of 17 days to a timed AI was previously used, the 19 day interval reduces the variability to estrus (Lamb et al., *Theriogenology* 53:691, 2000). Intervals of less than 17 days result in poor synchronization (Kesler et al., *J. Anim. Sci.* 74:2885, 1996). In addition to synchronizing estrus in estrus-cycling heifers, the procedure hastens and synchronizes fertility in prepubertal heifers (Imwalle et al., *Biol. Reprod.* 58:1432, 1998). We have conducted a field study with approximately 1,500 heifers. All heifers were synchronized with the MGA/PGF procedure with a 19 day interval from MGA to PGF. Producers then bred the heifers using two of three methods permitting two comparisons: breeding at estrus vs. timed AI at 72 h and timed AI at 72 h vs. timed AI at 60 h along with an injection of GnRH. Results from these studies will be presented and suggest that timed AI may be used with the efficacious MGA/PGF procedure to synchronize estrus with equal or better results than breeding at estrus.

Key Words: MGA, PGF, Estrus

215 A review of methods to synchronize estrous cycles of postpartum suckled beef cows with the oral progestin, melengestrol acetate. D. J. Patterson*, *University of Missouri, Columbia*.

This review will consider recently developed methods to control estrous cycles of postpartum beef cows with melengestrol acetate (MGA). Melengestrol acetate is an orally active progestin that will suppress estrus and prevent ovulation in cattle when consumed on a daily basis. The duration of feeding may vary among the various protocols that are available, but the level of feeding ($.5 \text{ mg-cow}^{-1}\cdot\text{day}^{-1}$) is consistent and critical to success. Feeding MGA for 14 days followed by injection of prostaglandin $F_{2\alpha}$ (PG) 17 to 19 days after MGA withdrawal was developed as an effective method of estrous cycle control for heifers (Brown et al., 1988; Lamb et al., 2000). Studies in postpartum beef cows identified significant improvements in specific reproductive endpoints among cows that received MGA prior to the administration of PG compared with cows that received PG only, including increased estrus response and improved synchronized conception and pregnancy rates (Patterson et al.,

1995). Recently, an improvement in synchrony of estrus was reported without compromising fertility in postpartum beef cows that were pretreated, either short- or long-term, with MGA prior to GnRH and PG. We proposed the general hypothesis that progestin (MGA) treatment prior to the GnRH-PG estrus synchronization protocol would successfully: 1) induce ovulation in anestrous postpartum beef cows; 2) reduce the incidence of a short luteal phase among anestrous cows induced to ovulate; 3) increase estrus response, synchronized conception and pregnancy rates; and 4) increase the likelihood of successful fixed-time insemination. Protocols that utilize this sequential approach to estrous cycle control include the MGA[®] Select (Wood et al., 2001) and 7-11 Synch (Kojima et al., 2000) protocols. Modified programs that utilize the GnRH-PG protocol with MGA feeding between injections have also been included. The flexibility in matching specific protocols with the particular management system involved is a major advantage in using MGA to control estrous cycles in beef cows.

Key Words: Estrus Synchronization, Progestin, Beef Cows

216 Synchronization of estrus in beef cows and beef and dairy heifers with EAZI-Breed Cattle CIDR Inserts (intravaginal progesterone inserts) and Lutalyse Sterile Solution. John R. Chenault*, *Pharmacia Animal Health.*

EAZI-Breed[™] Cattle CIDR[®] Inserts are T-shaped intravaginal inserts consisting of silicone containing 10 % progesterone by weight molded over a nylon spine. Inserts are administered for 7d with an injection of Lutalyse[®] Sterile Solution administered on day 6. Progesterone from the insert suppresses estrus and ovulation in cattle that spontaneously regress their corpus luteum (CL) during the administration period; upon insert removal these animals express a synchronized estrus. Lutalyse is used to synchronize estrus in cattle with a functional CL at the end of the insert administration period. Therefore, when used together estrus can be synchronized in all estrous cycling cattle. Multi-location studies have been conducted with beef cows (6 locations), beef heifers (5 locations) and dairy heifers (4 locations). (Lucy et al JAS 79:982:2001) These studies indicate that estrus is effectively synchronized with this treatment regimen. Animals inseminated following removal of inserts had conception rates comparable to that observed in contemporary controls. In addition, estrus was advanced in about 50 % of non-cycling beef cows and heifers. Induced estruses had fertility comparable to that observed in estrous cycling contemporary controls. This treatment regimen may not be acceptable for use with timed AI because follicular development is not controlled resulting in estrus distributed over 2 to 3 days. The following treatment regimen has been evaluated in beef cows with fixed time AI; 100 mcg GnRH at the time of insert administration, 7 days later insert removal and Lutalyse injected, and 100 mcg GnRH and AI 48 hours after insert removal. Pregnancy rate to fixed time AI was improved in beef cows with inserts administered relative to that observed in beef cows with the same treatment regimen without the insert (Co-Synch program). (Lamb et al JAS 79:2253:2001) However, increased pregnancy rate has not been observed consistently across studies. (Johnson et al; JAS 78: Supp 1:218:2000).

Key Words: Estrus Synchronization, Beef Cows and Heifers, CIDR Inserts

217 Incidence of postpartum anestrus in suckled beef cattle: Treatments to induce estrus, ovulation and conception. J.S. Stevenson* and S.K. Johnson, *Kansas State University.*

Early herd conception is limited by the proportion of cows that have resumed normal estrous cycles (CYC) at the beginning of the breeding season. In 2,892 beef cows studied, only 55% were CYC before the breeding season. Body condition (BC), parity, and days postpartum (DPP) influenced the proportion of CYC as assessed by concentrations of blood progesterone. As BC increased from <4 to ≥5.5 (1 = thin and 9 = fat), CYC increased linearly ($P < 0.001$) by $16 \pm 1\%$ for each unit increase in BC. Cyclicity increased linearly ($P < 0.001$) from 34% (<50 d) to a peak of 66% after 80 DPP. For every 10-d interval from <50 to >80 d, CYC increased ($P < 0.05$) by $6 \pm 0.5\%$. Compared to older cows, fewer (LS constant = $-22 \pm 2\%$; $P < 0.01$) 2-yr-old cows were cycling, despite calving up to 3 wk earlier. Ovulation was induced in noncycling cows after injection of GnRH or GnRH plus progestin (7-d norgestomet [NORG] implant, 7-d CIDR, 14-d feeding of melengesterol acetate [MGA] ending

12 d before GnRH). In noncycling cows, percentages of ovulation induction were: 46% after an injection of GnRH; 73% after GnRH + CIDR; 19% after GnRH + NORG; 79% after MGA preceding GnRH; and 21% after PGF_{2α} (PGF) alone (control). Ovulation induction was limited in 2-yr-old cows until BC scores were ≥5.0. Induction of ovulation increased linearly ($P < 0.05$) by $8.4 \pm 2\%$ for each unit increase in BC. Expression of estrus in noncycling cows treated with GnRH + NORG + (PGF 7 d after GnRH; 53%) was greater ($P < 0.001$) than in those treated with GnRH + (PGF 7 d after GnRH; 25%) or controls treated with only PGF (15%). Conception after AI based on detected estrus or timed AI at 48 h after PGF increased ($P < 0.05$) quadratically with advancing DPP. Among noncycling cows, conception rates were: 36% after GnRH + PGF; 49% after GnRH + CIDR + PGF; 48% after GnRH + NORG + PGF; 0% after MGA preceding GnRH + PGF; and 18% after PGF alone. Anestrous suckled cows responded best to treatments that included GnRH plus a short-term progestin to maximize ovulation induction before PGF, and expression of estrus and conception after PGF.

Key Words: Anestrus, GnRH, Progestin

218 Past, Present, and Future impact of ultrasound technology on beef cattle reproductive research and management strategies. G. C. Lamb*¹ and C. R. Dahlen¹, ¹*University of Minnesota.*

The area that has arguably benefited more from the development of ultrasound technology than any other area is reproduction in large animals. Ultrasonography is now commonly used for fetal sexing and early embryonic detection. Ultrasound offers researchers the ability to visually characterize the uterus, fetus, ovary, corpus luteum, and follicles and has been used to monitor the growth and atresia of individual antral follicles, which usually takes place in two or three waves during the estrous cycle. Ultrasonographically classified follicle stages have also shown to be correlated closely with the ability of follicles to produce hormones (estrogen:progesterone and estrogen:androstenedione ratios, inhibin concentrations, and IGF-binding proteins) indicative of follicular health. We recently determined by ultrasound that the diameter of the ovulatory follicles prior to the second injection of GnRH in a CoSynch estrous synchronization system was related to overall pregnancy rates. Cows that had follicles >12 mm had greater ($P < 0.01$) pregnancy rates than those with follicles ≤ 12 mm. In addition, cows that had follicles from 16.0 to 17.9 mm had the greatest ($P < 0.01$) pregnancy rates. With ultrasonography we determined the incidence of embryonic loss in beef cows from d 25 of gestation to day 45 to be 6.5%, whereas, we noted a 4.2% incidence of embryonic loss in beef heifers initially ultrasounded at day 30 of gestation and subsequently palpated rectally at between day 60 and 90 after insemination. Fetal sexing is fast becoming a common management tool in beef cattle enterprises with accuracy in sex determination exceeding 97%. The applications of ultrasound used by scientists include the ability to monitor follicular characteristics, ovarian function, and aid in follicular aspirations and oocyte retrieval. In the future, as technology improves technicians will have an opportunity to use the internet or video conferencing for ultrasound image analyses. With every new technological development, scientists, veterinarians, and producers discover new possibilities for the use of reproductive ultrasound to enhance the scientific merit of research or improve reproductive efficiency in cattle operations.

Key Words: Ultrasound, Beef Cattle, Embryonic Loss

219 Factors affecting fertilization in estrus-synchronized cattle. R. G. Saacke*, *Virginia Polytechnic Institute and State University.*

Pregnancy rate due to the inseminate, female population, and/or reproductive strategy employed is complex and often involves an interaction of the three. Fertilization failure or failure in embryogenesis, which comprise pregnancy rate, can both be of seminal origin alone. In addition, time of insemination in relation to manipulation of the female and resulting expression of estrus and time of ovulation also interact with seminal traits. This interaction appears to be at the level of sperm numbers accessing the ovum and post fertilization, affecting very early embryonic development. Clearly, males differ in the numbers of sperm required to reach maximum fertilization rate. Males requiring more sperm would be considered to have compensable seminal deficiencies. These include a number of known problems (viability and morphology

based) and unknown factors (functional and molecular traits) precluding sperm access to the ovum. Depressed fertility of an inseminate, independent of sperm dosage, would reflect presence of uncompensable deficiencies. These would be associated with the presence of fertilizing sperm that are incompetent to maintain the fertilization process or subsequent embryogenesis once initiated, with most failures occurring prior to maternal recognition of pregnancy. Such sperm would preempt fertilization by competent sperm. Chromatin aberrations in morphologically normal or near normal spermatozoa from abnormal semen samples appear to be the best candidates for uncompensable seminal deficiencies; however, more work is necessary in this area. Six-day-old non-surgically recovered bovine ova/embryos have been effective in their use to evaluate compensable and uncompensable seminal deficiencies as well as reproductive strategies, including time of insemination relative to ovulation. These ova/embryos provide information on fertilization status and embryo quality as well as quantitative and qualitative data regarding associated accessory sperm. Thus, they permit the separation of reproductive failure by fertilization (sperm access to the ovum) from that by embryonic development (competence of the fertilizing sperm and fertilized oocyte) in the pursuit of efficient reproductive strategies and the role of the male/inseminate in optimizing such strategies.

Key Words: Fertilization, Embryo Quality, Accessory Sperm

220 Efficacy of Ovsynch and Ovsynch plus CIDR treatments on effecting a cure in dairy cows with cystic ovarian disease. T.L. Steckler*, T.F. Lock, G.C. McCoy, and D.J. Kesler, *University of Illinois*.

An experiment was conducted to determine if the inclusion of an intravaginal progesterone releasing insert (CIDR) during synchronization would improve pregnancy rates (PR) to a timed AI in lactating dairy cattle. The experiment included 57 primi- and multiparous lactating dairy cows from the University of Illinois Dairy Research Unit. The cows were assigned to a 2x2 factorial design with Ovsynch with or without CIDR and the presence (Cystic; n=20) or absence (Control; n=37) of cystic structures as the main effects. Cows were diagnosed per rectum to have a cystic (≥ 25 mm) structure(s) present on one or both ovaries during scheduled herd health checks. Confirmation, 7 to 10 d later, of cystic structure(s) was performed on d -7 via ultrasonography. Cows were administered the Ovsynch protocol (100 g of GnRH on d -7, 25 mg of PGF on d 0, 100 g GnRH on d +2, AI 16 h after the last GnRH injection). CIDRs (1.9 g progesterone) were administered from days -7 to 0. Ovarian structures were monitored on days -7, +2, +7, +14, +21, and +28. Pregnancy was determined via ultrasonography on d +35 and +56 and palpation on d +84. Two cows were removed from the trial prior to d +35 and 3 after d +35 due to non-reproductive health reasons and were not included in any further analysis. PR for Controls+CIDR were 76%, 59%, and 53% vs 61%, 61%, and 56% for Controls on d +35, +56, and +84, respectively. PR for Cystic+CIDR were 44%, 44% and 44% vs 36%, 22%, and 22% for Cystic on d +35, +56, and +84, respectively. All (100%) Cystic+CIDR cows ovulated and formed a corpus luteum vs 82% of Cystic cows. A difference ($P < 0.05$) was detected in the number of cows (no CIDR) with cystic structures on d +28 in Control and Cystic cows (5% vs 36%, respectively). However, when a CIDR was administered during synchronization no difference ($P > 0.3$) was observed in the number of cows with cystic structures on d +28 (6% vs 22% in Control+CIDR and Cystic+CIDR, respectively). In summary, Ovsynch effects a cure in cows with cystic ovarian disease and the 28 d post-treatment incidence of ovarian cysts in cows administered Ovsynch+CIDR was similar to Control cows unlike cows administered Ovsynch alone.

Key Words: Cystic Ovarian Disease, CIDR, Ovsynch

221 Synchronization of ovulation in suckled beef cows with GnRH-CIDR-PGF and timed insemination at 48 or 60 h after PGF₂ α . S.K. Johnson*, K.R. Harmoney, and J.S. Stevenson, *Kansas State University*.

The objectives of this study were to compare intervals of 48 or 60 h between PGF and timed AI (TAI) and administration of GnRH or Saline at TAI in a GnRH-CIDR-PGF synchronization protocol. Cows from two herds were blocked by breed, calving date, and parity and assigned randomly to a 2 x 2 factorial arrangement of treatments: 1) TAI at 48 or 60 h after PGF; and 2) administration of GnRH or Saline at TAI.

Herd 1 (n=139) consisted of primiparous and multiparous Angus, Simmental, and Hereford cows. Herd 2 (n=212) consisted of multiparous, Angus-based, crossbred cows. All cows received 100 μ g GnRH i.m. and a used intravaginal progesterone insert (CIDR) on d -7. On d 0, CIDRs were removed and PGF (25 mg) was injected i.m. Blood serum samples for progesterone (P4) analysis were collected on d -14, -7, 0, and at TAI. Cows with P4 ≥ 1 ng/mL (HI) on d -14 and/or d -7 were assumed to have resumed normal estrous cycles (CYC) and cows with P4 < 1 ng/mL (LO) on d -14 and -7 were classified as non-cycling (NC). Pregnancy rate (PR) to TAI was determined on d 35-36 via transrectal ultrasonography. Cows inseminated at 48 or 60 h after PGF had similar PR (80/179; 45% vs. 87/181; 48%, respectively). GnRH at TAI tended ($P = 0.12$) to increase PR compared to cows receiving Saline at TAI (90/178; 51% vs. 77/182; 42%). Cycling cows with HI P4 on d 0 and LO P4 at TAI had higher ($P < 0.05$) PR if they received GnRH compared to Saline at TAI (49/86; 57% vs. 36/93; 39%, respectively). Treatment with GnRH or Saline at TAI did not influence PR in NC cows with HI P4 on d 0 and LO P4 at TAI (24/51; 47% vs. 28/49; 57%, respectively). Non-cycling cows with a P4 rise above baseline on d 0 of 0.4 to 0.9 ng/mL (CIDR effect ?) had greater ($P < 0.03$) PR if GnRH was given at TAI compared to Saline (10/16; 63% vs. 5/19; 26%, respectively). Timed AI at 48 or 60 h after PGF in a GnRH-CIDR-PGF protocol was equally effective. Administration of GnRH at TAI improved conception in all CYC cows and in some NC cows depending on their P4 status.

Key Words: Timed Insemination, Beef Cows, GnRH

222 Effet of handling intensity on blood acid-base balance in slaughter weight pigs. T. M. Bertol^{1,2}, M. Ellis¹, D. N. Hamilton¹, and F. McKeith¹, ¹University of Illinois at Urbana-Champaign, IL, ²CNPq, Brazil.

This study was carried out to investigate the impact of different handling intensities on blood acid-base balance in slaughter weight swine (140.62 \pm 9.75 kg). Pigs were moved individually through a handling facility (12.2 x 0.91 m) for six laps (up and down the passage), with or without the use of electric prods. Three treatments were compared involving different levels of the electric prod usage: 1) None (n = 3); 2) Moderate (three times per lap; n = 5); 3) Intense (five times per lap; n = 5). Blood was collected from the jugular vein one h before the handling test (HT) to establish baseline values (BLV), at the end of the HT, and at 2 h after the completion of the HT. The blood was analyzed for pH, lactate, PCO₂, PO₂, HCO₃, TCO₂, base excess, and SO₂ using an Automatic Clinical Analyzer (i-STAT Corporation, Princeton, NJ). BLV for blood parameters were similar ($P > 0.05$) across all treatments. In addition, all blood parameters had returned to BLV and were similar ($P > 0.05$) across treatments 2 hours after the end of the HT. Pigs that were moved without the use of electric prods showed limited changes ($P > 0.05$) in blood parameters at the end of the HT relative to BLV. At the end of the HT, blood lactate was increased (7.58 \pm 1.39, 13.38 \pm 1.08, 18.83 \pm 1.08 mmol/L; for treatments 1, 2, and 3, respectively; $P < 0.001$) and pH decreased (7.29 \pm 0.04, 7.17 \pm 0.03, 7.09 \pm 0.03; $P < 0.01$) for pigs that were handled with electric prods. In addition, blood levels for HCO₃ (30.0 \pm 1.70, 29.4 \pm 1.32, 18.0 \pm 1.32 mmol/L; $P < 0.001$), TCO₂ (31.7 \pm 1.81, 31.8 \pm 1.40, 19.8 \pm 1.40 mmol/L; $P < 0.001$), and base excess (3.67 \pm 1.84, 0.80 \pm 1.42, -12.00 \pm 1.42 mmol/L; $P < 0.001$) were reduced for pigs on the Intense compared to the other two treatments. The results of this study show large differences in blood parameters resulting from different intensities of animal handling suggesting that blood acid-base balance may be a useful index to monitor animal responses in research studies as well as under commercial conditions.

Key Words: Acid-Base Balance, Animal Handling, Pigs

223 Survival of ram sperm stored at 39° C in ram semen diluter, caprogen or synthetic oviduct fluid. S. Meredith*, G. Dudenhoeffer, D.O. Kiesling, A. Woldeghebriel, A.N.V. Stewart, and R. Savage, *Lincoln University*.

The primary objective of this experiment was to determine how long sperm motility could be maintained at 39° C in extenders/media designed for room temperature storage. Spermatozoa were also evaluated with Hoesch and chlortetracycline (CTC) to determine % alive and capacitation status, respectively. Semen was collected from 2 to 4 rams, pooled, and diluted to 50 x 10⁶ sperm/ml in the appropriate extender. Extenders used were ram semen diluter (RSD-1), caprogen and synthetic oviductal fluid (SOF). Within 30 minutes of extension, 39° C incubation

was initiated. One-half of the samples were incubated in 5 % CO₂/95 % air, and the remaining half were incubated in 100 % N₂ gas. Motility, live-dead, capacitation and acrosomal status were evaluated at 0, 4, 24, 48 and 72 h of incubation. Osmolarity was 295, 353 and 280 mOsm for RSD-1, caprogen and SOF, respectively. There was no difference between N₂ gas and 5 % CO₂/95 % air on motility scores when incubated in caprogen or SOF. Motility scores in RSD-1 were not different at 4, 24 or 72 h of incubation. Motility was greater ($P \leq .05$) at 48 h when RSD-1 cultured sperm were incubated in CO₂ and air ($1.1 \pm .2$) than in N₂ gas ($.6 \pm .2$). RSD-1 maintained motility for 24 h (motility score $2.5 \pm .4$) which was better ($P \leq .01$) than both caprogen (motility score $1 \pm .1$) and SOF (motility score $.7 \pm .1$). There was no motility at 48 and 72 h of culture when sperm were incubated in caprogen or SOF, and only minimal motility when incubated in RSD-1 ($.9 \pm .2$ and $.2 \pm .1$, respectively). Live/dead staining followed the same trend except that over 10 % were classified as live in all treatments at 72 h of incubation. Neither incubation time, type of media, nor gas used for incubation caused sperm to be classified as capacitated or acrosome reacted. In conclusion, RSD-1 was the best extender tested for body temperature storage of ram sperm, although significant motility was maintained for only 48 h.

Key Words: Semen Extenders, Sperm Motility, Body Temperature

224 Effects of zeranol upon luteal maintenance and fetal development in peripubertal gilts. W.E. Trout¹, C.T. Herr², B.T. Richert², W.L. Singleton², and M.A. Diekman^{*2}, ¹ *Trout Technologies*, ² *Purdue University*.

The objectives of this study were to determine whether zeranol could maintain hCG-induced corpora lutea (CL) in peripubertal gilts and to examine the gross effects of zeranol on the number of fetuses and their development. Crossbred gilts (171 ± 0.3 d of age, 109.1 ± 1.4 kg) were blocked by weight and ancestry to control ($n=40$) or treatment ($n=40$) groups. To induce ovulation and CL formation, treated gilts received 500 IU of hCG and a Ralgro[®] ear implant (zeranol, 36 mg; d 0). On d 42, treated gilts received two 10 mg injections of Lutalyse (PG) spaced 6 h apart. Treated gilts not displaying estrus within 7 d of PG treatment on d 42 received an additional 20 mg of PG on d 49. All gilts were checked once daily for estrus with a mature boar starting on d 3. On d 45-58, gilts detected in estrus were inseminated twice 24 hours apart with pooled semen via AI. Blood samples were obtained on d 0, 7, 18 and 42 and analyzed for serum progesterone (P4). Bred gilts were slaughtered on d 58-62 of gestation. Zeranol appeared to maintain hCG-induced CL function based on 45% of treated gilts vs 0% of control gilts having elevated P4 on d 7, 18 and 42 ($P < .0001$). Of gilts detected in estrus and bred on d 45-58, 16/21 treated gilts and 16/18 control gilts were pregnant at slaughter on d 58-62 of gestation. Number of fetuses (7.5 vs 12), fetal weight, (83 vs 121 g), fetal length (117 vs 132 mm) and fetal survival (45% vs 78%) were reduced ($P < .001$) by zeranol. These data indicate that treatment of peripubertal gilts with a 36 mg zeranol implant did maintain pseudopregnancy, but did not significantly improve estrous synchronization while causing dramatic deleterious effects upon the fetuses.

Key Words: Ralgro, Pseudopregnancy, Swine

225 Feeding melengestrol acetate (MGA) to resynchronize repeat estrus in beef heifers previously synchronized using a MGA/Prostaglandin F_{2α} protocol. C. R. Dahlen* and G. C. Lamb, *University of Minnesota*.

One hundred twenty-one commercial beef heifers were used to determine whether feeding melengestrol acetate (MGA) for 7 d, after an initial estrous synchronization with an MGA/Prostaglandin F_{2α} (PGF) protocol,

would resynchronize repeat estrus in heifers that either had an embryo transferred or were previously observed in estrus, and initiate cycling in heifers that were not previously observed in estrus. Initial estrous synchronization was achieved by feeding 0.5 mg MGA daily for 13 d, followed 19 d later with one 25-mg injection of PGF. Seventy-four heifers received embryos 7 d after observed estrus. Heifers were randomly assigned to one of two treatments: 1) heifers were fed 0.5 mg MGA daily for 7 d, beginning 15 d after PGF (Resynch; $n = 61$); or 2) heifers did not receive MGA from d 15 to d 21 after PGF (Control; $n = 60$). If observed in estrus (observed visually 4x daily, from d 10 to d 31 after PGF), heifers were inseminated following the am/pm rule. On d 35 and d 71 after PGF, transrectal ultrasonography was used to determine the presence of a viable fetus. Of the 34 Resynch heifers receiving an embryo, 23 were pregnant, whereas 22 of the 41 Control heifers receiving an embryo were pregnant. The percentage of heifers detected in estrus from d 23 to d 31 was greater ($P < .01$) for Resynch heifers (28/30 [74%]) than Control heifers (16/38 [42%]). Estrus was induced (i.e., a heifer in estrus that had not previously been observed in estrus) in 11 of 15 Resynch heifers and 7 of 12 Control heifers (73% vs. 58%, respectively). Conception rates were similar for Resynch (15/28 [54%]) and Control (10/16 [63%]) heifers. Overall pregnancy rates after 2 estrous synchronizations were 62% (38/61) for Resynch heifers and 53% (32/60) for Control heifers. We conclude that feeding MGA to resynchronize repeat estrus in commercial beef heifers may increase the percentage of animals observed in estrus, without altering pregnancy rates.

Key Words: Estrous Synchronization, Beef Heifers

226 Response of the small intestine to pregnancy in Romanov and Columbia ewes. A.N. Scheaffer, J.S. Luther*, D.R. Arnold, M.L. Bauer, D.A. Redmer, J.S. Caton, and L.P. Reynolds, *North Dakota State University*.

Pregnancy results in a large increase (50% by the end of gestation) in energy demands. To evaluate small intestinal responses to the metabolic demand of pregnancy, litter-bearing (R, $n = 4$) and standard (C, $n = 3$) ewes, which were mated to rams of their respective breeds, were slaughtered on day 130 of gestation. Weights of the gravid uterus, fetuses, total small intestine, and jejunum were determined. In addition, a sample of jejunum was perfusion-fixed, embedded in paraffin, and sectioned. Jejunal tissue sections were used to quantify vascularity (vascular density = percentage of tissue occupied by capillaries, arterioles, and venules) using morphometric techniques. Compared with C ewes, R ewes had a smaller ($P < 0.01$) live weight (LW; 98.1 vs 44.8 ± 7.9 kg) and maternal body weight (MBW [LW - (blood+gut fill+gravid uterus)]; 68.2 vs 24.5 ± 7.8 kg). Compared with C ewes, R ewes also had smaller ($P < 0.01$) individual fetal (4.7 vs 2.2 ± 0.3 kg) but similar ($P = 0.41$) total fetal (6.6 vs 4.5 ± 0.32 kg) weights. However, when scaled to maternal body weight, R ewes had greater ($P < 0.01$) gravid uterine weights than C ewes (282 vs 163 ± 30 g/kg MBW). R ewes also had greater ($P < 0.01$) total small intestinal and jejunal weights (37.1 vs $17.3 \pm 2/5$ g/kg MBW and 24.2 vs $9.9 \pm 2/1$ g/kg MBW, respectively). In addition, jejunal vascularity was greater ($P < 0.05$) in R compared with C ewes (20.2 vs $12.1 \pm 2.7\%$). These data demonstrate that, compared with Columbia ewes, Romanov ewes support a 40% greater gravid uterine mass per unit of maternal body weight. The intestinal response to this greater metabolic demand of pregnancy in Romanov ewes is reflected by a 2-fold larger, 70% more vascular small intestine. Supported by NIH grant HL64141 to DAR and LPR.

Key Words: Pregnancy, Small Intestine, Vascularity

Ruminant Nutrition And Forages

227 Changes in nutritive value of tall fescue hay as affected by natural rainfall and initial moisture concentration at baling. J. E. Turner, W. K. Coblenz, D. A. Scarbrough, R. T. Rhein*, K. P. Coffey, D. W. Kellogg, C. F. Rosenkrans, Jr., and J. V. Skinner, Jr., *University of Arkansas*.

Relatively little is known about the combined effects of rain damage and spontaneous heating on the storage characteristics and nutritive value

of tall fescue (*Festuca arundinacea*, Schreb.) hay. Our objectives were to assess the effects of these variables for tall fescue hay in five different management situations. Kentucky 31 tall fescue infected with the fungal endophyte (*Neotyphodium coenophialum*) was packaged in conventional rectangular bales at 99 (low), 164 (ideal), and 225 (high) g kg⁻¹ of moisture (L, I, and H respectively) prior to rainfall and at 246 g kg⁻¹ of moisture after a 2.26 cm rainfall event (H-R) and at